Links among Money Prices and Output in Oil exporting Countries

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Abstract

This paper examine the dynamic causal chain among money, income, prices and oil revenues in a panel of 11 selected oil exporting countries by using panel unit root tests and panel cointegration analysis. The cointegration analysis established that the money supply, real GDP, CPI and oil revenues were found to be cointegrated suggesting existence of long-run relationship. The results show a strong causality from money to prices, output with weak reverse causation from price and income to money. The findings reveal that oil revenues and money supply are the most exogenous variables in system. In addition, the evidence of indicates that inflation is a monetary phenomenon in the short and long-run.

JEL classifications: C32, E31, E40, E51
Keywords: Health expenditure; Causality, Panel Cointegration

1. Introduction

Economist and policy makers have been always concerned with the nature of the causation between money and real economic activities. The proponents of Quantity Theory of Money claim that money supply is exogenous. This is in contrast with Mundell’s proposition that money supply accommodates changes in output and income, being endogenous. Cagan (1965) also argues that money supply conveys both endogenous and exogenous properties. For short-run and cyclical fluctuation, he proposed a relation in which the money supply is endogenously determined by changes in real sector. However, he asserts that in the long-run, money supply is independent of real economic activities and is determined exogenously.

Different schools of economic thought have postulated various relationships between money and other macroeconomic variables. Monetarists claim that monetary policy matter and money causes economic variables such as prices and output. While Keynesians argue that real output and prices cause money supply through demand for money, although yet a positive monetary shock would increase both economic activity and price level through the interest rate and investment variables. The New Keynesians and the monetarists claim that money supply may be independent of output and prices, influencing them as an exogenous variable. The real business cycles school point out the neutrality of money in affecting level of economic activity and argue output and prices are the major determinant of supply of money, reflecting endogeneity of the money supply. The causal relationship among money and other macroeconomic variables such as income, interest rates and price level, implied by the existing macroeconomic schools still remains vague. The issue, therefore, as to the dynamic causal relationships even in the Granger temporal sense rather than in the structural sense remains unsettled and is an empirical one.

In this study, we examine the causality issue between money and income in a panel of 11 selected oil exporting countries by means of applying a dynamic panel framework allowing us to capture both inter-country and inter-temporal variation. We include prices and oil revenues as additional variables to the money-income nexus. So a four variable model is formulated comprising money, GDP, prices and oil revenues. Firstly, existence of a long-run relationship among these four variables is tested by using Pedroni (1995, 1999) panel cointegration approach. Panel Granger causality test is applied on the corresponding
vector error correction model to examine short-run causal relationship between the variables. The paper is organized in four sections. A brief study of previous empirical studies is presented in section 2. Section 3 discusses the methodology, data and results. Section 4 concludes.

2. Review of Literature

One of the main tasks in empirical macroeconomics is the investigation of the interaction between nominal and real variables and endogeneity of money. Different schools in economic literature have proposed various relationships between money and other macroeconomic variables. Before the real business cycle theory, the prevailing thought was that aggregate demand and money stimulus, such as monetary shocks, would have a significant effect on the real economic activity, implying that money would cause economic activity. The concern among the Keynesians, the monetarists, the new classicals and the new Keynesians were not whether monetary shocks had any effect on output but the nature and the transmission mechanisms of these shocks. The Keynesians argued that money changes would influence both economic activity and price level through the interest rate and investment. The monetarists agreed with Keynesian transmission channel in the short run but in the long run they came to the same result with classical economists that money is neutral. The new classical economists decomposed monetary changes into expected and unexpected ones and argued that only unanticipated money would result in an income changes. The new Keynesians came to non-neutrality of money, at least in the short run, because of nominal and real rigidities, market failures and imperfections. The real business cycle theory argued that money supply endogenously responds to income increase through banking sector creating more inside money for increased transaction demand. Money will have no effect on output. It will only lead interest rates and the price level. The real business cycle theory postulate money supply as endogenous, output being determined exogenously.

According to early post-Keynesian scholars such as Joan Robinson (1956), Kaldor (1970), Moore (1979a, 1979b, 1983, 1988) and Davidson (1972), money appears in the economy along with production when banks hold contracts with firms. As the economy grows, banks increase their loans to meet the growing needs of the economy, such as paying wages or remunerating other factors of production. The creation of money is thus parallel to the creation of income. As is argued by Joan Robinson (1956) and by post-Keynesians in general, the supply of money increases with the needs of production, in response to expectations of aggregate demand, through the banking system (see Arestis and Eichner, 1988). There are three distinct theories of money supply endogeneity: those presented by Accommodationists’, Structuralists’ and the Liquidity Preference School (see Kaldor, 1970; Basil Moore, 1988; Palley, 1996; Arestis and Howells, 1996).

Chick (1986) distinguishes monetary causality through stages of financial development. In the first stage, money is entirely exogenous; saving determines investment. The causality runs from bank deposits to reserves, and finally to loans, money being exogenous. In the next stage, the banks are able to expand lending beyond their reserve capacity through deposit multiplier. Endogenous money is thus viewed as the result of institutional changes, defined as the ability of the banking system to increase the supply of loans with no prior expansion of bank reserves. Yet, Louis-Philippe Rochon (2004), Lavoie (1992) and Lavoie (1996) argue that money has always been endogenous, irrespective of the historical period.

After the seminal paper by Friedman and Meiselman (1963) that launched this view for the first time that the direction of causality runs from money to output, there has been contradictory empirical evidence in the literature about the money-output relationship. This relationship has been extensively investigated in empirical literature by researchers for both developed and developing countries over different sample periods and provided the contradictory evidences on this issue, see for example: Ramachandra (1986), Miller (1991), Friedman and Kuttner (1992), Stock and Watson (1993) Boucher and Flynn (1996), Jamie Emerson (2005), Herwartz and Reimers (2006), Majid (2007), Saatcioglu and Korap (2008) and Chimobi and Uche (2010).
Besides the above mentioned ones, the literature is full up with many other studies on the money-output relationship, a detailed discussion of which does not seem necessary. To sum up, there is no definite evidence to support the money-income causality one way or the other, either for the United States or for other countries. The evidence does not only differ across economies, but also within a particular economy. Much of the differences can be attributed to data, specification or methodology used.

3. Data, Methodology and empirical results

We apply a four variable model to examine the causal relationship between money and GDP with prices and oil revenues included in model as conditioning variable along with these two variables. Data used in the analysis are annual time series during the period 1970-2009 on (logarithm of) broad money (m), consumer price index (p) and real GDP (y) and real oil revenues (oil) in constant 2000 prices in local currency units, for the 11 oil exporting countries including Iran, Kuwait, Saudi Arabia, United Arab Emirates, Bahrain, Oman, Algeria, Nigeria, Mexico, Venezuela and Ecuador. The data were obtained from World Development Indicators (WDI) 2010, published by the World Bank and OPEC Bulletins. The choice of the starting period was constrained by the availability of data.

To test the nature of association between the variables while avoiding any spurious correlation, the empirical investigation in this paper follows the three steps: We begin by testing for non-stationarity in the four variables of m, p, y and oil. Prompted by the existence of unit roots in the time series, we test for long run cointegrating relation between variables at the second step of estimation using the panel cointegration technique developed by Pedroni (1995, 1999). Granted the long run relationship, we explore the causal link between the variables by testing for granger causality at the final step.

3.1. Panel Unit Roots Results

The panel data technique referred above has appealed to the researchers because of its weak restrictions. It captures country specific effects and allows for heterogeneity in the direction and magnitude of the parameters across the panel. In addition, it provides a great degree of flexibility in model selection. Following the methodology used in earlier works in the literature we test for trend stationarity the four variables of m, y, p and oil. With a null of non-stationary, the test is a residual based test that explores the performance of four different statistics.

Next we apply the panel unit root tests proposed by Levin, Lin and chu(2002), Breitung(2000), Im, Pesaran and Shin(2003) and Fisher-type tests using ADF and PP tests (Maddala and Wu(1999) and Choi(2001)). The Levin, Lin, and Chu (LLC), Breitung, and Hadri tests assume that the persistence parameters are common across cross-sections. Alternatively, the Im, Pesaran, and Shin (IPS), and Fisher-ADF and fisher-PP tests allow persistence parameters to vary freely across cross-sections. All the panel unit root tests have a null hypothesis of unit root in the series in the panel. Results for panel unit root tests are reported in Table 1.

The first four rows report the panel unit root statistics for m, y, p and oil at the levels. As it can be inferred from this Table, we cannot reject the unit-root hypothesis in most cases when the variables are taken in levels and thus any causal inferences from the series in levels are invalid. The last four rows report the panel unit root statistics for first differences of m, y, p and oil. The results for first differenced series indicate rejection of the null of non-stationary at 1% level for all variables. It may, therefore be concluded that the four variables of m, y, p and oil are unit root variables of order one, or, I (1) for short.
Table 1: Test of Unit Roots for m, y, p and oil

<table>
<thead>
<tr>
<th>variables</th>
<th>Levin-Lin-Chu t stat</th>
<th>Breitung t-stat</th>
<th>ADF Fisher stat</th>
<th>PP-Fisher stat</th>
<th>IPS stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>2.65</td>
<td>1.14</td>
<td>47.66</td>
<td>74.60***</td>
<td>1.89</td>
</tr>
<tr>
<td>y</td>
<td>1.74</td>
<td>4.36</td>
<td>12.76</td>
<td>14.79</td>
<td>-0.88</td>
</tr>
<tr>
<td>p</td>
<td>3.54</td>
<td>1.51</td>
<td>49.15</td>
<td>64.74**</td>
<td>-0.001</td>
</tr>
<tr>
<td>oil</td>
<td>-1.23</td>
<td>3.45</td>
<td>12.76</td>
<td>8.54</td>
<td>2.71</td>
</tr>
<tr>
<td>∆m</td>
<td>-7.81***</td>
<td>-8.23***</td>
<td>163.19***</td>
<td>237.38***</td>
<td>-9.11***</td>
</tr>
<tr>
<td>∆y</td>
<td>-2.69***</td>
<td>-3.12***</td>
<td>106.34***</td>
<td>146.03***</td>
<td>-5.71***</td>
</tr>
<tr>
<td>∆p</td>
<td>-3.47***</td>
<td>-3.18***</td>
<td>104.23***</td>
<td>362.98***</td>
<td>-4.51***</td>
</tr>
<tr>
<td>∆oil</td>
<td>-15.25***</td>
<td>-9.56***</td>
<td>225.00***</td>
<td>400.91***</td>
<td>-12.81***</td>
</tr>
</tbody>
</table>

***significant at 1%

3.2. Panel Cointegration Results

At the second step of our estimation, we look for a long run relationship among m, y, p and oil using the panel cointegration technique developed by Pedroni (1995, 1999). This technique is a significant improvement over conventional cointegration tests applied on a single country series. While pooling data to determine the common long run relationship, it allows the cointegrating vectors to vary across the members of the panel. The cointegration relationship we estimate is specified as follows:

\[ m_t = \alpha_i + \delta_t + \beta y_t + \gamma p_t + \theta oil_t + \epsilon_t \]  

(1)

Where \( \alpha_i \) refers to country effects and \( \delta_t \) refers to trend effects. \( \epsilon_t \) is the estimated residual indicating deviations from the long run relationship. With a null of no cointegration, the panel cointegration test is essentially a test of unit roots in the estimated residuals of the panel. Pedroni (1999) refers to seven different statistics for this test. Of these seven statistics, the first four are known as panel cointegration statistics; the last three are group mean panel cointegration statistics. In the presence of a cointegrating relation, the residuals are expected to be stationary. These tests reject the null of no cointegration when they have large negative values except for the panel-\( v \) test which reject the null of cointegration when it has a large positive value. All of these seven statistics under different model specifications are reported in Table 2. The statistics for all different model specifications suggest rejection of the null of no cointegration for all tests except the panel and group \( \rho \) tests. However, according to Perdroni(2004), \( \rho \) and pp tests tend to under-reject the null in the case of small samples. We, therefore, conclude that the four unit root variables m, y, p and oil are cointegrated in the long run.

Table 2: Results of Panel Cointegration test

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<tbody>
<tr>
<td></td>
<td>2.92***</td>
<td>-0.61</td>
<td>-2.77***</td>
<td>-3.54***</td>
<td>0.82</td>
<td>-5.59***</td>
<td>-3.18***</td>
</tr>
</tbody>
</table>

***significant at 1%

3.3. Panel Causality Results

Cointegration implies that causality exists among the series but it does not indicate the direction of the causal relationship. With an affirmation of a long run relationship among m, y, p and oil, we test for Granger causality in the long run relationship at the third and final step of estimation. Granger causality itself is a two-step procedure. The first step relates to the estimation of the residual from the long run relationship. Incorporating the residual as a right hand side variable, the short run error correction model is estimated at the second step. Defining the error term from equation (1) to be \( ect_t \), the dynamic error correction model of our interest by focusing on money (m) and GDP (y)is specified as follows:
Δyₜ = αₘ + βₘ ectₜ₋₁ + γₘl Δmₜ₋₁ + γₘ₂ Δmₜ₋₂ +
δₘ₁ Δyₜ₋₁ + δₘ₂ Δyₜ₋₂ + λₘ Δpₜ₋₁ + ϕₘ Δoilₜ₋₁ + φₘ₂ Δoilₜ₋₂ + eₚₜ

Δmₜ = αₜ + βₜ ectₜ₋₁ + γₜl Δmₜ₋₁ + γₜ₂ Δmₜ₋₂ +
δₜ₁ Δyₜ₋₁ + δₜ₂ Δyₜ₋₂ + λₜ Δpₜ₋₁ + λₜ₂ Δpₜ₋₂ + ϕₜ Δoilₜ₋₁ + ϕₜ₂ Δoilₜ₋₂ + eₜₜ

Where Δ is a difference operator; ect is the lagged error-correction term derived from the long-run cointegrating relationship; the β and βₚ are adjustment coefficients and the εₚ and εₜ are disturbance terms assumed to be uncorrelated with mean zero.

Sources of causation can be identified by testing for significance of the coefficients on the lagged variables in Eqs (2) and (3). First, by testing H₀: γₘl = γₘ₂ = 0 for all i in Eq. (2) or H₀: δₜ₁ = δₜ₂ = 0 for all i in Eq. (3), we evaluate Granger weak causality. Masih and Masih (1996) and Asafu-Adjaye (2000) interpreted the weak Granger causality as ‘short run’ causality in the sense that the dependent variable responds only to short-term shocks to the stochastic environment.

Another possible source of causation is the ect in Eqs. (2) and (3). In other words, through the ect, an error correction model offers an alternative test of causality (or weak exogeneity of the dependent variable). The coefficients on the ect represent how fast deviations from the long run equilibrium are eliminated following changes in each variable. If, for example, βₘl is zero, then GDP does not respond to a deviation from the long run equilibrium in the previous period. Indeed βₘl = 0 or βₜl = 0 for all i is equivalent to both the Granger non-causality in the long run and the weak exogeneity (Hatanaka, 1996).

It is also desirable to check whether the two sources of causation are jointly significant, in order to test Granger causality. This can be done by testing the joint hypotheses H₀: βₘl = 0 and γₘl = γₘ₂ = 0 for all i in Eq. (2) or H₀: βₜl = 0 and δₜl = δₜ₂ = 0 for all i in Eq. (3). This is referred to as a strong Granger causality test. The joint test indicates which variable(s) bear the burden of short run adjustment to re-establish long run equilibrium, following a shock to the system (Asafu-Adjaye, 2000).

The results of the F test for both long run and short run causality are reported in Table 3. As is apparent from the Table, just the coefficients of ect and y are significant in the money equation which indicates that long-run and short run causality run from y to money. Indeed prices and surprisingly oil do not have significant effects on money. So among the system variables, just real economic activities strongly Granger-causes money supply. Strong causation was found from money and prices to GDP at short- and long run with oil having least effect at 10% level on output, raising the resource curse hypothesis in these countries. Oil revenues are affected just slightly by other variables in long run, identifies as the most exogenous in the system. exogeneity of oil indicate that this variable does not adjust towards long-run equilibrium. Behind oil revenues, Money supply stands as the most exogenous variable.

Moreover, the interaction terms in the Health equation are significant at 1% level. These results imply that, there is Granger causality running from GDP and Oil to health expenditure in the long-run and short run, while health have a neutral effect on GDP in both the short- and long-run. In other words, GDP is strongly exogenous and whenever a shock occurs in the system, health expenditure would make short-run adjustments to restore long-run equilibrium.
4. Conclusion

The purpose of this study was to test for dynamic causal chain among money supply, income, prices and oil revenues for 11 oil-exporting developing countries over the period 1970-2009. The panel integration and cointegration techniques are applied to investigate the relationship among the four economic series. Utilizing Granger Causality within the framework of a panel cointegration model, our findings suggest that there is a bi-directional causation between money supply and prices with prices having stronger effects on money than the reverse causation. Besides the governments borrowing from the banking system which contributed to inflation in these countries, it also seems that financial markets of all kinds are not well developed in oil countries and their influence in the economy is trivial. Hence, it seems that the main alternative to holding money is spending on goods and services. As a consequence, it is most likely that the supply of money is the most important factor that determines the spending on goods and services and therefore causes the prices. The cointegration and causal relationships detected among the variables indicate that money supply is not neutral in the short- and long run, inflation being a monetary phenomenon and the monetary policy can be efficient in stabilization of the price level. However, beside money supply some, structural elements play a significant role in generation of inflation as well e.g. movements in GDP or oil revenues. Moreover, active monetary policy to stabilize short-run fluctuation in prices must be handled with caution, since money supply is found to Granger cause real output and tight monetary policy is likely to reduce speed of the long-run economic growth. In this juncture, an effective co-ordination between monetary and fiscal policy would enable to achieve sustainable economic growth within the environment of price stability.

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References


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11- Davidson, P. (1972), Money and The Real World. London: Macmillan,


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